

REMARKS

Reconsideration and allowance are respectfully requested in light of the above amendments and the following remarks.

At the outset, it is noted that a Petition to Make Special was granted in this application, so that this application is entitled to expedited examination.

Further, the Applicant wishes to thank the examiner for the courtesy shown to his attorney during a telephone interview on January 11, 2005. The following includes a summary of the points discussed during the interview.

Claims 11, 19, 23, 24, and 31 have been amended to highlight patentable features of the present invention. Specifically, claims 11, 19, 23 and 31 have been amended to recite a coding operation previously recited in dependent claims 12 and 24, and claims 12 and 24 have been revised in light of the amendments to claims 11 and 23. An editorial change has been made to claim 11.

Turning now to the pending prior art rejections:

(1) claims 11, 13, 19, 21, 22, 36 and 38 stand rejected under 35 USC 103 as unpatentable over Wang in view of Franger;

(2) Claim 12 stand rejected under 35 USC 103 as unpatentable over Wang in view of Franger and Chen et al.;

(3) Claims 23, 25, 31, 33, 34, 41 and 43 stand rejected under 35 USC 102(b) as anticipated by Wang;

(4) Claim 24 stands rejected under 35 USC 103 as unpatentable over Wang in view of Chen et al.;

(5) Claims 20, 35, 37 and 39 stand rejected under 35 USC 103 as unpatentable over Wang in view of Franger and Applicant's admitted prior art; and

(6) Claims 32, 40, 42 and 44 stand rejected under 35 USC 103 as unpatentable over Wang in view of Applicant's admitted prior art.

The Applicant respectfully traverses these rejections.

A. The Invention

The present invention is directed to overcoming the deficiencies of the prior art described at application page 2, line 1 through page 5, line 6, wherein rate matching is performed prior to interleaving of the rate-matched data, with the result that when a burst error occurs in a propagation path at portions with not-increased bits, the BER characteristic deteriorates when the receiver side corrects errors. The present inventor recognized that in the prior art technique in which the repetition is performed with respect to the whole data before interleaving, the increased bits due to the repetition are partial to a portion within a frame, resulting in the poor BER characteristic when burst error occurs. To avoid this effect in the prior art, the inventor conceived the present invention in which the repetition after interleaving avoids a mal-distribution of the increased bits due to the repetition within the frame. See application page 5, line 9 through page 6, line 6.

Thus, in the present invention, on the encoding processing side, first, error correction coding is performed on input data including a plurality of bits; then, the coded bits are interleaved; and then, rate matching is performed by processing the interleaved data by increasing or puncturing the number of bits of interleaved data. On the decoding processing side, the data encoded by the encoding side are processed, first, by a second rate matching process involving repeating bits punctured by the encoder or puncturing bits repeated by the encoder and, then, by a deinterleaving process of the bits provided by the second rate matching process.

More particularly, both of independent claims 11 and 19 are directed to radio transmission wherein, first, error correction coding is performed on input data including a plurality of bits; then, the coded bits are interleaved; then, rate matching is performed including alternatively selecting between (i) repeating a part of the interleaved bits and (ii) puncturing a part of the interleaved bits. Claim 20 is directed to reception of data transmitted by the method of claim 19, including, first, alternatively selecting between repeating and puncturing bits, and, then, deinterleaving data. Claim 35 is directed to receiving data transmitted by the method of claim 22, including, first, alternatively selecting between repeating and puncturing bits, and, then, deinterleaving data.

Further, both of independent claims 23 and 31 are directed to radio transmission wherein, first, error correction coding is

performed on input data including a plurality of bits; then, the coded bits are interleaved; and then, rate matching is performed including repeating a part of the interleaved bits. Claims 32 and 40 are directed to, first, receiving data transmitted by the methods of claim 31 and 34, respectively, then, puncturing bits, and then, deinterleaving the data.

B. The Applied Art

Wang discloses a turbo-coder which uses two algorithms of repetitive turbo coding using repetition and interleaving in the encoder. The first algorithm is to perform interleaving on the original N-bit block before repeating the bits. In this way, the input sequences to both constituent encoders are in the form of successive r-tuple identical bits. The second algorithm is to repeat each and every bit of the information sequence before interleaving. In this way, the repeated sequence is provided to two independent interleavers of size rN.

Accordingly, in Wang's first approach (cited by the office action), the turbo-coder operates to interleave an N-bit block of data, and then to repeat each and every bit of this block to create two identical blocks of the N interleaved bits. Wang's purpose for repeating the block of interleaved bits is to increase the Hamming distance of the resulting turbo-coded data to obtain a greater coding gain than is achievable without repeating the bits prior to performing the turbo coding. The coding rate is changed based on r;

by repeating r times, a rate 1/3 turbo code becomes a rate  $1/(2r+1)$  turbo code.

The Office Action states incorrectly (see page 3, line 16 and page 5, lines 6-7) that Wang does not specifically disclose a coder that performs error correction coding. To the contrary, Wang does specifically disclose error correction coding, given that Wang discloses a turbo-coder which is, by definition, an error correction coder.

Further, the office action at page 2, last 5 lines and page 4, last two lines, states that section 4 of Wang describes Wang's turbo-coder as a "rate matcher." Although Wang does incidentally provide rate changing in the sense that the number of repetitions r will yield different coding rates and a turbo-code of varying length, the rate changing provides at most very limited rate matching and does not provide adaptability to most frame rates. Those skilled in the art would consider Wang's device as a turbo-coder, and, if they thought of Wang's "rate matching" at all, they would consider it as an incidental effect of Wang's algorithms.

Franger has been cited for a disclosure of a rate matcher that performs puncturing.

Chen et al. has been cited for a disclosure of a coder that performs error correction coding of the input data to provide error correction encoded data, wherein, after the error correction coding by the coder, the interleaver performs the interleaving of the error correction encoded data.

The Applicant's admitted prior art merely discloses a coding device in which, first, the number of bits is increased, and then, the bits are rearranged in an interleaver.

C. Rejection of Amended Independent Claims 11 and 19 and Claims 12, 13, 21, 22, 36 and 38 Dependent Therefrom under 35 USC 103 Based on Wang in View of Franger and Chen<sup>1</sup>

As noted above, the Office Action is in error in stating that Wang does not specifically disclose a coder that performs error correction coding. To the contrary, Wang discloses a turbo-coder which is, by definition, an error correction coder.

Further, the office action states that section 4 of Wang describes Wang's turbo-coder as a "rate matcher." However, although Wang does incidentally provide rate changing in the sense that the number of repetitions  $x$  will yield different coding rates and a turbo-code of varying length, the rate changing provides at most very limited rate matching and does not provide adaptability to most frame rates. Accordingly, those skilled in the art would consider Wang's device as a turbo-coder, not a rate matcher, and, if they thought of Wang's "rate matching" at all, they would consider it as merely an incidental effect of Wang's algorithms.

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<sup>1</sup> Claims 11 and 19 have been amended to include the features of claim 12, which was rejected based on Chen. Thus, Chen will be discussed in this section.

In contrast to Wang, present claims 11 and 19 define a radio transmission technique employing, first, error correction coding, thereafter, interleaving of the error correction coded data, and thereafter, rate matching of the interleaved error correction coded data by selectively alternatively employing puncturing and repetition.

Given that Wang's device is a turbo-coder with merely ancillary effects of rate changing, it is clear that those skilled in the art would not have been led to consider changing the basic operations of Wang's device to achieve improved rate matching. This is especially true because, as discussed in detail below, the modification of Wang proposed in the office action would be contrary to, and would tend to defeat, the purpose of Wang's invention. The office action's position that those skilled in the art would have been led to modify Wang to obtain improved rate matching is based on improper hindsight.

The office action states that Wang's "rate matcher" lacks a puncturer. See, office action, page 2, last 5 lines. To supply this puncturer, the Office Action relies on Franger for rate matching with puncturing:

"A rate matcher comprises a repeater for repeating a part of the bits interleaved by the interleaver. (See pg. 51, section 4. Repetitive Turbo Code). Wang does not disclose a puncturer to puncture a part of the bits interleaved by the interleaver. However, Frenger et al disclose a rate matching comprises (sic) ... a puncturer." (office action, page 2, last 5 lines).

The basis for the Office Action's proposal appears to be that Franger discloses a rate matcher that performs puncturing and that it would have been obvious to replace Wang's turbo-coding repetition step with Franger's puncturing operation to "provide a larger span of available channel coding rates, a flexible coding scheme suitable for future mobile radio communication systems." The Office Action proposes that it would have been obvious from Franger's rate matching using puncturing to modify Wang's turbo-coding repetition operation to a turbo-coding-rate-matching operation using puncturing.

There are several significant problems with this rejection.

First, given that Wang's device is a turbo-coder using repetition to increase the strength of the turbo-code (and achieving only an incidental rate changing effect), those skilled in the art would not have looked to Franger's rate matcher to modify Wang's turbo-coder. Those skilled in the art would in no sense have considered Franger and Wang as substitutes for one another. Franger would not have provided motivation to those skilled in the art to modify Wang's turbo-coder to expand the turbo-coder's rate matching capabilities. Rather, it is submitted that the sole motivation for the office action's even considering Wang's rate-changing effects and to consider such a modification of Wang comes from hindsight provided by the Applicant's claimed invention, which recites interleaving and rate-matching operations. There is no suggestion or motivation in Wang or Franger or anywhere

else, that would have led those skilled in the art to modify Wang's turbo-coder to include puncturing.

Secondly, if Wang's turbo-coder were modified to replace the repetition with puncturing, the purpose of Wang's turbo-coding scheme would be destroyed. The combination of Frenger's puncturing operation into Wang would not have been obvious because it would be counter to the purpose of Wang's invention. If Wang's repetition operation were replaced with Frenger's puncturing operation, this modified device could not provide the increased Hamming distance and the resulting coding gain that motivated Wang to modify a conventional turbo-coding algorithm to include the repetition operation of his repetitive turbo coding algorithm. As is well-settled, where a proposed modification would render the invention of the reference unsatisfactory for its intended purpose, there is no suggestion or motivation to make the proposed modification. See, *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984) and MPEP §2143.01, fifth bolded heading. For at least this reason, the proposed combination of Wang and Frenger is not obvious.

Thirdly, the office action's proposal to modify Wang in view of Frenger would result in a device that would not achieve true rate-matching capabilities. The modification would result in a turbo-coding operation involving interleaving then puncturing or repetition. As noted above, Wang's repetition includes only limited and ancillary rate-changing that is not adaptable to a full range of frame lengths. The use of an alternative puncturing operation would not overcome this result. And further, when

puncturing is employed alternatively to repetition, this would destroy the purpose of Wang's invention which is to provide increased Hamming distance and increased coding gain.

Chen does not cure the above-discussed deficiencies of Wang and Franger.

With respect to Chen, cited against claim 12, the office action proposes that:

"Wang and Frenger ... do not specifically disclose a coder that performs error correction coding of the input data to provide error correction encoded data, wherein, after the error correction coding by the coder, the interleaver performs the interleaving of the error correction encoded data. However, Chen et al disclose a coder that performs error correction coding of the input data to provide error correction encoded data, wherein, after the error correction coding by the coder, the interleaver performs the interleaving of the error correction encoded data ... Therefore, it would have been obvious ... to incorporate a coder that performs error correction coding of the input data to provide error correction encoded data, wherein, after the error correction coding by the coder, the interleaver performs the interleaving of the error correction encoded data as taught by Chen et al into the invention of Wang and Frenger...."

As noted above, this statement is erroneous, given that Wang's turbo coder is by definition an error correction coder. Further, the Applicant notes that Chen merely discloses an error correction technique involving error correction encoding, then interleaving. Chen does not discuss rate matching, puncturing or repetition. Wang discloses a turbo-coding technique (error correction coding) which includes interleaving. In Wang, the repetition and interleaving are performed in the operation of the turbo-coding (error correction coding). According to the above facts, even if Chen were combined into Wang, it would provide only error

correction coding (interleaving, then repetition), then further interleaving.

In sum, Chen does not provide any suggestion or motivation to modify Wang's technique of interleaving then repeating in a turbo-coding (error correcting) technique or Franger's rate matching to achieve the subject matter of present claims 11 or 19.

Accordingly, it is submitted that claims 11 and 19 and all claims dependent therefrom are allowable over the individual or combined teachings of the applied references.

D. Rejection of Independent Claims 23 and 31 and Claims 25, 33, 34, 41 and 43 Dependent Therefrom under 35 USC 102 Based on Wang

Both of independent claims 23 and 31 are directed to radio transmission wherein, first, error correction coding is performed on input data including a plurality of bits; thereafter, the coded bits are interleaved; and thereafter, rate matching is performed including repeating a part of the interleaved bits.

As noted above, Wang discloses repetition and interleaving in a repetitive turbo-coding technique. The office action at page 4, last 2 lines, states that Wang includes a rate matcher. As stated above, Wang's turbo-coding operation does incidentally provide rate changing in the sense that the number of repetitions  $x$  will yield different coding rates and a turbo-code of varying length. But, to the extent rate changing occurs, it is the result of the coding operation. Further, independent claims 23 and 31 recite error

correction coding on input data prior to interleaving and rate matching. Wang lacks this subject matter.

Thus, Wang fails to disclose the subject matter of independent claims 23 and 31 wherein, first, error correction coding is performed on input data including a plurality of bits; then, the coded bits are interleaved; and then, rate matching is performed including repeating a part of the interleaved bits.

Accordingly, due to these deficiencies, Wang fails to anticipate claims 23 and 31 and the claims dependent therefrom.

E. Rejection of Claim 24 under 35 USC 103 as unpatentable over Wang in view of Chen et al.

Claim 24 depends from claim 23 and thus is allowable for at least the reasons noted above for the allowability of claim 23.

F. Rejection of Claims 20, 35, 37 and 39 under 35 USC 103 as Unpatentable over Wang in view of Franger and Applicant's Admitted Prior Art

These claims depend directly or indirectly from the above-discussed independent claims and thus are allowable for at least the reasons given in connection with allowability of their respective base claims.

G. Rejection of Claims 32, 40, 42 and 44 under 35 USC 103 as Unpatentable over Wang in view of Applicant's Admitted Prior Art

These claims depend directly or indirectly from the above-discussed independent claims and thus are allowable for at least the reason given in connection with their respective base claims.

H. Conclusion

The Applicant respectfully submits that the Office Action's conclusion of obviousness is based on improper hindsight reasoning that requires knowledge gleaned only from applicant's disclosure as a guide for picking and choosing isolated features of the prior art to reconstruct the claimed invention. See, *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988); *In re Dembicza*, 175 F.3d 994, 50 USPQ2d 1614 (Fed. Cir. 1999). Here, the Applicant's own disclosure has been used as a guide for piecing together the isolated features of Wang, Franger, Chen and the Applicant's admitted prior art to obtain the claimed invention. This is the essence of improper hindsight.

According to claims 11, 19, 23 and 31, the present invention involves error correction coding of input data including plural bits, interleaving the coded data, and then rate matching the interleaved data. The significant advantages of the invention are summarized at application page 5, line 9 through page 6, line 6.

The piecemeal approach of the present Office Action in constructing a combination of references allegedly achieving the present claimed invention is apparent in that:

(1) In the portion cited in the office action, Wang discloses a repetitive turbo-coding (error correcting) technique in which the bits of a data block are interleaved and then the block is repeated to achieve an increased Hamming distance and coding gain; those skilled in the art would view Wang's repetition as for the purpose of improving the strength of the turbo-code and not for rate-matching purposes; if they considered Wang's rate matching effects at all, they would view them as only incidental or ancillary; those skilled in the art would not have been led to significantly reconstruct Wang's turbo-coding operations to achieve an improved rate-matching effect;

(2) Franger discloses a rate matcher using puncturing or repetition; Franger is relied upon for allegedly teaching alternatively employing puncturing instead of repetition in Wang to achieve a greater range of rate matching; however, as noted above, those skilled in the art would not have thought of significantly reconstructing Wang's turbo-coding operation for the purpose of increased rate matching, and further, puncturing would destroy Wang's purpose of achieving increased Hamming distance;

(3) Chen merely discloses error correction coding, then interleaving and does not add anything to cure the deficiencies of Wang and Franger; the Office Action does not provide a cogent reason why one skilled in the art would be led to modify Wang's

turbo-coding process (which includes interleaving then repetition) to include further interleaving after the turbo-coding based on Chen; and

(4) the Applicant's admitted prior art merely discloses, first, increasing the number of bits, and then, rearranging the bits in the interleaver; the Office Action fails to provide a reason why one skilled in the art would consider the admitted prior art, which teaches increasing the number of bits then interleaving, as suggesting any modification of Wang's turbo-coding including repetition then interleaving, to lead to the subject matter of claims 11, 19, 23 and 31.

Given that the requisite motivation or suggestion or reason to combine or modify the references is missing, it is submitted that the rejections are unwarranted. Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988); *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). Here, the office action has failed to establish obviousness.

Accordingly, it is submitted that all pending claims recite allowable subject matter. A notice of allowance is respectfully solicited.

If any issues remain that may best be addressed through a telephone communication, the examiner is requested to telephone the undersigned at the local Washington, D.C. telephone number listed below.

Respectfully submitted,

Date: January 26, 2005

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